CANADIAN PRAIRIES GROUP OF CHARTERED ENGINEERS

NEWSLETTER

Winter 2016 Edition

2016 Annual General Meeting

The Annual General meeting will be held at Fort Calgary on January 30, 2015. As always we have a fantastic presentation planned and we are expecting this to be our biggest event to date.

Alberta Winner takes International Prize in Present Around the World Competition

Details of Robert Mayall's journey from the Calgary PATW to the Worlds, and his taking of the coveted first prize that he now shares with some of the youngest and best presenters in the world.

Announcing the Retirement of a Long Standing Member from the Executive Committee

For the last 25 years Bob Enever has been an active part of the CPGCE. We are sad to see him go from the Executive but we are sure he will continue to succeed in his future endeavors just like he has done with us in the past quarter century.

British Army Training Unit Suffield (BATUS) Spectrum of Operations

Look inside for recaps of the great technical presentations held in the Fall and Winter including a fascinating talk on the British Army Suffield Training Unit.

ice Institution of Civil Engineers
Institution of Mechanical Engineers
IET The Institution of Engineering and Technology
The Institution of Structural Engineers

Chairman's Notes Winter 2016

Hello everyone. I hope you have all had a wonderful Christmas holiday. My two-year term as the Chair will end at the next AGM on January 30th 2016 when Colin Pollard will take over. Colin has been an active member of the CPGCE Executive Committee for a number of years, serving as the Secretary until 2013. So I am confident that the CPGCE will continue to flourish in his very capable hands.

As I look back on my term, I am grateful for the wonderful support I received from everyone in the CPGCE. Our Executive is now a good blend of age, experience, and institution representation. But for our continued success, we do need new members for succession planning, to replace some senior members who will be retiring soon.

So if you are interested in joining the CPGCE Executive Committee at the next AGM, please visit our website www.cpgce.org to view our activities. If you need more details, then please contact our Secretary Rick Marshall at Secretary@cpgce.org.

The 2016 AGM will take place on Saturday January 30th 2016 at Fort Calgary. Registration details are on the website. I hope you will be able to join us for the AGM and also meet up with your friends, "should auld acquaintance be forgot…"

Our Technical Presentations have continued to attract large numbers thanks to the quality of the speakers and the varied range of topics. The March Presentation was by Connor Scheu, the winner of the 2014 Calgary IET's Projects Around the World (PATW) competition, titled *"To the Ends of the Earth – Ocean Science of the Antarctic"*.

Well, our 2015 Calgary PATW winner Robert Mayall was the winner of the Global Final Competition held in London at the IET Achievements Award in November 2015, after winning the America's Regional final. His winning presentation *"Ending the Guessing Game for Infectious Patients"* will be scheduled as a Technical Presentation sometime in 2016. So please watch out for the announcement of the date.

The details of Robert's success and the PATW competition can be found in:

http://www.cpgce.org/images/CPGCE_-_PATW_2015_Winner.pdf

I would like to thank one of our longest serving members, Bob Enever who is stepping down as Treasurer in January. He has done an admirable job as our Treasurer. Thank you Bob for your long service and for your article in this Newsletter.

Finally, on behalf of the CPGCE Executive Committee, I wish all of you and your families A Very Happy, Healthy and Successful 2016.

Mohamed Jaffer

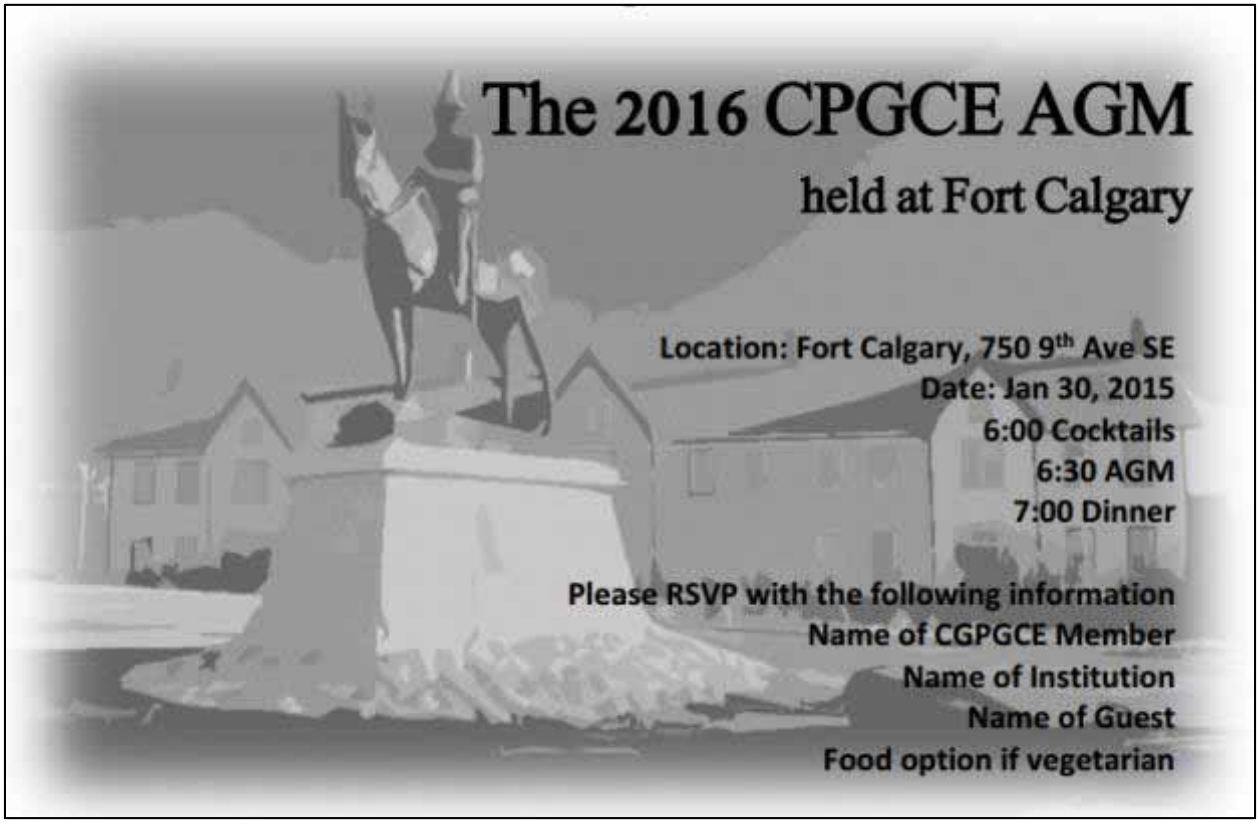
Annual General Meeting 2016

The CPGCE AGM and Technical Presentation will be held at Fort Calgary on January 30th, 2016. Cocktails will be served at 6:00PM, followed by the AGM at 6:30PM, and dinner at 7:00pm. Tickets are $25. Registration is to be completed online at this link:
https://localevents.theiet.org/061600

Please complete a separate registration for your gues/partner. Under the "*Special Instructions*" section, in the box titled "*Guest name and dietary requirements*", please state the name of your institution, if a vegetarian option is required. But please do not mention the name of your partner/guest as they need their own registration.

This year we are proud to have a technical presentation by Shock Trauma Air Rescue Society (STARS) Air Ambulance.

We are expecting to have this be our biggest event yet. Hope to see you there.



Present Around the World Winner 2016

Our very own Robert Mayall has been announced as the 2016 Present Around the World (PATW) winner in London, England. This is an amazing achievement as Robert won the Calgary, and then the Americas round with some tough competition. Calgary has a very strong track record for the competition, producing three Americas winners out of the last five years. Congratulations Robert and best of luck in the future.

The next PATW is tentatively scheduled for March 2018 at the University of Calgary. The competition is a great way to practice and get feedback on technical presentation skills.

Any student between the ages 18-30 can participate by making a ten minute technical presentation. The presentation can be on any topic the student chooses. Past Calgary winners have gone on to compete at the America's and the World levels. Two of our current executive members are past participants in the competition.

The CPGCE is very proud to announce that they will be the main sponsor for the PATW this year and as always look forward to providing judges for the event.

For further information on the PATW please visit http://conferences.theiet.org/patw/.

Retirement of a Long Standing Member

It is with regret that we inform the membership that one of our long standing members will be retiring from the executive this year, Bob Enever. Bob has been a member of the CPGCE for 25 years and has contributed greatly to the committee in that time.

As a special treat for everyone we are re-publishing two of Bob's previous articles from the newsletter archives.

Forensic Horology

Bob Enever 2002

Some years ago I received a phone call from a local auctioneer who deals in antiques. He had run a local Antiques Roadshow in Lethbridge for

charity and someone had offered an incomplete clock movement for evaluation. The clock was described as having the typical brass face and movement of a longcase (grandfather) clock

and it had a maker's name. The name was Wyke and Greene, Liverpool. In the clockmaker's reference book they are dated as 1781-1805. I said that I would be interested in seeing the movement and perhaps buying it. I met the owner in Calgary and a deal was struck.

The owner advised me her deceased father, who had been born in the UK had brought it to Canada many years ago after trip back to England with the intention of fixing it up. The clock movement had a brass back dial with a gilt spandrel in each corner and someone had painted the bell and backplate black. The chapter ring (brass ring with hour numbers on) had large Roman numerals and it was only a single hand for the hours. Between the Roman numerals each section was divided into four. There are no minute markings around the chapter ring (there are five minute divisions between hour markings totaling sixty on a clock with minute hands). In the centre of the face was a second brass disc that sets an alarum (alarm). The brass nameplate is riveted to the dial.

The movement consisted of the traditional two brass plates but the width across the movement was about half that of a traditional clock movement. It had a pendulum and anchor escapement. It has a simple three-wheel train with pulleys to drive the clock movement and the alarm. The alarm consisted of a simple verge movement driven hammer on a bell powered by a second pulley. It was unlike any clock that I had seen before. What is it?

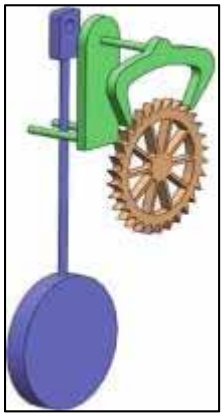
Typically old clock movements only come up for sale if the clock case has been lost in a fire and the movement survived or the case

was of such poor design it was not worth keeping, which is unusual. The movement as I noted was half the size of the regular 30 hour movement. The dial was obviously designed for an hour hand only (no minute hand) so that probably put it into the late 17th or early 18th century when time keeping accuracy (and interest) was such that a minute hand was considered unnecessary. In this era the clockmaker would engrave his name on the dial, as labour was cheaper than material. The curved brass nameplate does not match the curve of the chapter ring and careful examination showed that it had been riveted with small modern pin nails which were not rusty. Holes drilled in the faces showed that it had been done in the last few decades.

Verge escapement

Clocks of this style were made between 1680 and 1825. The clock movement plates have no signs of being changed from a verge to an anchor escapement, which puts the design most probably into the 18th century when verge movements had been completely replaced with anchor escapements. The latter are inherently more accurate. The brass posts from the dial line up exactly with the holes in the plates of the movement and the chapter ring similarly is a perfect fit to the dial. The dial and clock plates are held in place with tapered brass pins. There are no unused holes so those pieces are all original. The chapter ring would have been silvered but it since been polished off.

A cast iron weight, typically five lbs. (over two kilogramme) powers this clock design of this era. The weight is linked to the movement with ropes and later chains. The design of the pulleys with rusty iron spikes showed that it had been designed for use with ropes and weights rather than the later chain links, which require machined slot in the centre of the pulley to accommodate the ridge of the chain between shorter spikes. There would be a continuous rope loop with one weight, which drove both clock movement and the alarm. The quality of the brass plate used to fabricate the clock plates, wheels (gears) dial had no flaws and the wrought iron parts are of good quality. This supports a later rather than earlier manufacture. Early brass plate has inclusions and flaws. The design of the alarm consisted of a verge movement probably recovered from an earlier clock movement. The verge consists of a vertical shaft with dogs set at 90 degrees, which mesh with a crown type gear wheel. When the alarum is tripped by the clock movement, a weight pulls on the crown wheel, which oscillates back and forth driving the verge staff, which has a double-headed hammer on the end and strikes a cast brass bell.



Anchor escapement

Other observations the sophistication of the clock face and chapter ring design/manufacturing is greater than the simple clock alarum movement would justify. The clock face, about 10 inches (25 cm) square is larger than the movement would justify. The face should be 6 to 8 Inches (15 to 20 cm) square. The brass back plate for the dial has pieces removed to reduce weight and the amount of brass in the movement. This has not been finished to the quality of the front of the clock face. So what do the reference books say?

An abbreviated summary on Hooded wall clocks states, "Alongside latter day lantern clocks country makers produced a great number of

Hooded wall clocks. These are the true descendants of lantern clocks (16th and 17th early clock type with domed square brass case) with three wheeled one-day trains (it will run for 30 hours) and has a single hand. They almost never have striking mechanisms (do not strike the hour) but almost always have an alarum. These hooded alarum clocks were not infrequently made with anchor escapements and long pendulums. The combined bracket and cases or hoods are often pleasing in an unpretentious way and are nearly always made of oak though other woods are not unknown. They sometimes ‘grew’ trunks and bases to become 'grandmother' or miniature longcase clocks". There is also a similar clock called a hook and spike clock where the movement has two metal spikes facing backwards at the bottom of the movement and a hook at the top where it can be affixed to a wall. In around 1770 the fashion moved away from brass dials to painted dials for clocks.

I have the complete clock dial and movement from a hooded alarum clock from the third quarter of the 18th century so it is around 250 years old and it still works!

An engineer and his bike - an engineering education.

by Bob Enever

As a youth in England in the late 50s living in a village, my only transport was a bicycle. When I started to play rugby seriously for my grammar school some seven miles away in Oxfordshire, it entailed practising 4 nights a week after school and the only means of transport outside of the school bus was pedal power up and down three major hills. My father took pity on me and helped me with contributions from my paper round to buy a Norman moped with a 50 cc 2-cycle engine. At the age of 16 I was hooked on motorcycles and was about to learn many lessons in practical engineering. The moped would do about 25 mph (with a following wind) and probably developed at least 0.9 hp.

The speedometer went up 50 mph. There was the challenge, how to get the needle off the scale! I avidly read books on tuning Vincents, Nortons and Triumphs but to no avail, no one seemed to be racing 50cc mopeds in the TT at that time. Supercharging, desmodromic valve gear, high compression heads, none of these seem to have much relevance to an engine that bore a remarkable resemblance to lawn mower power units and two moving parts. Not exactly developed from Formula One racing lines. So turning my back on the theoretical aspects of motorcycle racing and my future training in the sciences I withdrew into the experimental mode of trial and error.

My father had talked about using 100 octane in sports cars from World War 2 fighters. It did not seem to be readily available in the village and higher octanes from the village pump made no difference. I had learned a basic difference between 2 and 4 stroke engines.

I added methanol with negative results, researched nitromethane but it did not seem to be available from Boots in Reading. When I asked the chemistry master at school about making nitromethane he looked at me suspiciously, which was probably because we had asked previously about improving home made bombs with oxygen boosters and then solid state rocket motors.

The first real result came about when I pulled out the silencer core. It made 10 times the noise. Now I was making progress. I finally got the moped to 53 mph (on the speedometer anyway) by approaching Peppard Hill at maximum speed with following wind, disengaging the clutch and freewheeling down a 1 in 8 gradient round a 90 degree turn and.... **success**!
Unfortunately the chain broke.

My next engineering lesson was that I realised, as all North Americans know, there is no substitute for cubic inches. I traded up to a 125 cc Capri scooter. This was Italian so obviously it had a thoroughbred engine with the lineage of Ducati, MV etc. and probably put out around 5 hp. It was also a little more streamlined and would do about 40 mph. It revved a lot higher and used to shed the occasional bolt. This was how I learnt that Europeans used foreign threads called metric, not proper ones using Whitworth. The local garage man told me this disparagingly when I attempted to buy replacements. Later it became more confusing when AF appeared on the scene.
To improve the performance I implemented my proven upgrade and removed the silencer core. My mother remarked that she knew when I was near home because she could hear me coming a mile or two away down the country lanes. I next took off the cylinder head decoked and polished the combustion head and attempted to increase the compression by putting a thinner gasket in. I did try to emery paper the head down and increase the compression ration but to little effect. I next played with the spark plug using a hotter model and experimented with the timing. The scooter did have a primitive carburettor rather than the tube and bent wire that the moped had. I found I could increase the revs, which made even more noise and did go a little faster. It had the unfortunate consequence of shedding bolts faster because of the increased vibration. Now I knew why on racing machines they wire all nuts and bolts to stop them falling off during a race.

I also threaded some of the stud tapings trying to tighten up the bolts and learnt about the failings of aluminium against steel. The scooter had smaller wheels than the moped so it had a lower centre of gravity, I thought it would corner faster because I could lean over farther. I soon discovered it was less stable in cornering because of lower gyroscopic stability from the smaller wheels.

I now moved away to university in Brighton some 90 miles from home and the scooter was too slow for such a distance. I upgraded to a Norman 250 cc with a Villiers 2T engine. At last real power, the bike developed 15 hp with a top speed of 75 mph. Now I was in a position to threaten John Surtees supremacy. The first major problem was that on one home trip the vibration caused carburettor cover to unscrew allowing excess air into the fuel, which eroded the piston crown and caused failure. A classic 2 stroke problem. Because it was a twin I struggled home on about 30% power. Lesson learnt two cylinders are more reliable than one.

I replaced the pistons and managed to crack the cast iron inlet manifold. I felt Araldite was unlikely to work in my efforts to make a repair. It was suggested I talk to the research support staff in the physics department. A brilliant move, I never realised such talented and skilled resources existed. A technologist looked at the pieces, heated them slowly, brazed them together, cooled slowly under bricks and smoothed them with a belt sander, a sound lesson in metallurgy.

On leaving university and discovering the decadence of full weather protection in a car, my enthusiasm for motorbikes waned somewhat. However I invested in a 500 cc Triumph Tiger at the time when all British manufactures were rapidly going bankrupt in the early 70s. I learnt a lot about oil seals and how in a vertical split crankcase it is hard to stop oil leaks.

Having been accepted in marriage my partner was not enthused about 2 wheel transport, so on emigrating to Canada I passed the bike onto my brother. A sign of maturity my wife encouraged.

In my recent second childhood I abandoned all my acquired technical knowledge and purchased a Triumph Bonneville. When I looked at the pool of oil under the crankcase, while trying to kick-start it, reality hit me. So I moved over to a Honda 500 cc, water cooled, V twin with electric starter and a 100% reliability.

I realised I had learnt something about engineering.

University of Lethbridge Pre-Engineering Students - Meet and Mingle evening

The University of Lethbridge has started an engineering course whereby students will do their first year in Lethbridge then be able to transfer seamlessly to other Universities, primarily the University of Alberta in Edmonton. As part of the students' introduction to engineering Brandie Lea, Faculty Development Officer, and Dan Furgason, Lecturer, organized a social evening for the students. Various industry personnel were invited including the CPGCE. Colin Pollard attended the evening on September 18.

In October Michael J. Mahon, Ph.D., President & Vice-Chancellor of the University gave an address to update the university and community about the progress of the past year. In his address he noted that several of the new programs introduced in 2015 are illustrating they are meeting the growing needs of the learners. The Pre-Engineering started in the fall of 2015 was fully booked. The interest in engineering within the local community and the community of professional engineers has been so overwhelming that discussions regarding the introduction of a new engineering program are in consideration as the University looks at growing its professional programs footprint.

The meet and mingle evening was attended by consulting professional engineers, government engineers and also industry personnel from companies like Pratt & Whitney and LaFarge. The evening allowed the new students to see just how wide the engineering field is. Though this event was very early in their engineering career it allowed them to glimpse the opportunities ahead and confirmed their desire to pursue engineering as a career.

The University runs a professional practice seminar course, acquainting students with the professional life of engineering, on Monday evenings from 6:00PM to 7:30PM with industry personnel offering talks on subjects such as engineering law and current projects to inform and inspire the students. If you desire to know more, or want to explore the possibility of presenting to the students please contact Brandie Lea, Faculty Development Officer on 403.329.2247.

Technical Presentation Summaries

British Army Training Unit Suffield (BATUS) Spectrum of Operations

September 9, 2015

Lt. Col. Nick Sealy-Thomas, SO2 Engineer BATUS and Gareth Davis MBE, Cubic Defence AWES Deputy Programme Manager

This well attended presentation highlighted the scope of operations and the technology used by the British Army Training Unit Suffield (BATUS), located at the vast training area of Canadian Forces Base Suffield in Alberta, Canada.

BATUS provides the British Army with its largest armoured training field, accommodating live-firing exercises up to the brigade level in near realistic operational scenarios with Area Weapons Effect System (AWES) advanced training infrastructure.

The presentation commenced with Lt. Col Sealy-Thomas providing an orientation of BATUS, describing the geography and environment of the military training grounds that encompass approximately 1700 square kilometers, located within the Canadian Forces Base Suffield. The area occupied by BATUS is large enough to contain all other British Army training grounds in use.

BATUS is a Big Place

The presentation highlighted some of the challenges of operating the largest British Army training base 7,000 kilometers from the UK. As guests of the Government of Canada, BATUS Command works closely with the Canadian Forces Base Command to ensure effective operations and sustainment of the training facilities.

BATUS is in active training mode six months of the year through the late spring, summer and early fall. While the winter period is used to replenish and service the extensive vehicle fleet in excess of 1000 British Army tactical combat vehicles; including Challenger 2 Main Battle Tanks, Warrior Fighting Vehicles and Army Air Corps Helicopters.

The duration of the BATUS training exercises, and size of the training area, allow all elements of a combined arms battle group (Infantry, Armour, Artillery, Engineers, Air Defence, Logistics and Equipment Support) to conduct realistic live firing training at all levels and practice sustaining this activity over a long period of time.


BATUS Night Time Live Fire Exercise

Four British Army Battlegroups (BG), and approximately 7000 soldiers, are trained at BATUS each year, as the UK's High Readiness Forces. The BATUS exercises, which last up to 35 days, consist of Live Fire and Tactical Effects Simulation (TESEX) exercises, the later with a live enemy force. The TESEX system allows for realistic operational training as it identifies when vehicles have been fired at hit, damaged or destroyed and informs soldiers when they are being fired at and if hit, what injuries they have sustained. A British Army regiment is located to BATUS each year to perform the role of 'enemy' for the exercises. The combination of; space to manoeuvre, live fire, simulation and supporting training infrastructure, provides invaluable operational training for soldiers that they may otherwise not experience.

Environmental stewardship is a critical priority for BATUS. Training exercises are conducted alongside an extensive prairie ecosystem, consisting of varied wildlife, such as rattlesnake, wolves to antelope and birds, such as burrowing owl and golden eagle.

The BATUS training grounds are collocated with significant oil and gas production infrastructure (10,500 production wells, connected by 10,000 km of pipeline). The oil and gas infrastructure usage is virtually invisible to exercising troops, largely restricted to the presence of tank proof well-head covers.

BATUS: a complex environment!

Despite the challenges of oil and gas infrastructure and the environmental ecosystem, BATUS provides the British Army with premiere training space. Providing an austere environment with enough space to allow for extensive manoeuvre within an integrated battlespace and world-class live firing capability providing a realistic replication of the army's Current Operations Environment (COE).

Tactical training scenarios are developed around a BG complement of soldiers; combat vehicles and equipment with brigade command in an exercise (Ex Prairie Storm) employing a mixture of Dry Training, Live Fire and TESEX based training components, with opposing (enemy) forces. An extensive weapons simulation environment and live action recording capabilities allow commanders to fully appreciate the training scenarios and performance of the BG.

BATUS training infrastructure provides situational awareness, training data capture and facilities that provide after action data to the training control centre, EXCOM. After action data collected is integrated into after action reports and include facilities to play back training scenarios. Thus providing commanders' valuable information on BG performance and the value of tactical approaches employed to meet training mission objectives.

EXCOM After Action Report Briefing

At the completion of the Ex Prairie Storm training scenarios, BG's are enhanced; as teams having trained in a realistic operational environment, are ready for operational deployment and aware of their strengths and weaknesses.

Mr. Davis provided an overview of the CUBIC Defence scope of support delivered to the BATUS, with its Area Weapons Effect System (AWES) and training infrastructure support designed to enrich the operational training environment and experience.

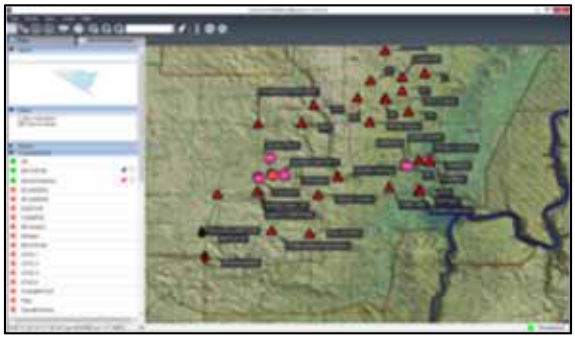
The AWES deployed at BATUS, provides British Army soldiers participating in live force-on-force training exercises with helmet arrays and vests studded with laser detectors, and weapons mounted with laser transmitters. The soldiers' laser transmitters fire a laser pulse at selected targets upon detection of the detonation of fired blank rounds during simulated battles. This action is completely transparent to the weaponfirer and the laser "bullets" simulate the direct-fire casualty effects of each soldier's or combat vehicle weapon system target engagements.

The AWES provides situational awareness of the battlefield by tracking each participant's and vehicle's position with GPS technology, recording their weapons engagements, including "hits," "misses," "kills" and shooter-to-target pairing for after-action review.

AWES also facilitaties integration of a wide array of weapons effects simulation into BATUS training exercises, inadiition to small arms and vehicle weapons direct-fire effects. Simulated weapons effects include, artillery, mortar fire, smoke, nuclear, biological and chemical attacks, mines and air-delivered munitions. Simulated natural and manmade obstacles can also be presented, just as real operational constraints occur on the battlefield.

BATUS: Live Fire Training in Full Force

A critical factor required for all BATUS training operations is safety. An extensive safety infrastructure is distributed across the BATUS training area, to ensure the highest levels of safety is maintained. Real time situational awareness and effective communications across the entire training area support safe operations, but are also required to support a realistic operational environment consisting of physical and simulated assets with capture of training performance data.



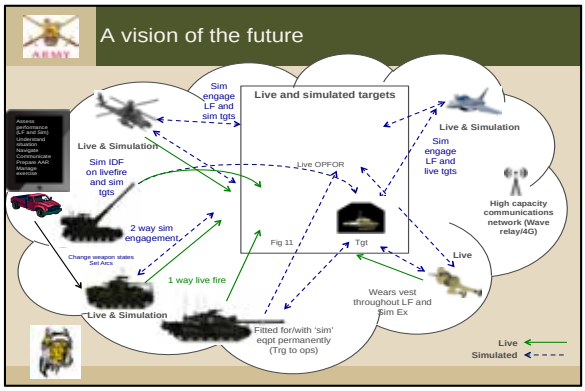
Integrated situational awareness supports effective training and safety during exercises

BATUS employs an extensive high-speed data communications network in addition to separate voice communications networks for safety and training management. The existing communications meshed networks include 4 channel AWES radios for “player” data, mixed 3G data networks for the Observer Controller Communications, Tracking, Exercise Enabling Network and Applications (XENA) and Remote Optical Video Enhanced Receiver (ROVER) terminals, with VHF voice for safety and Lynx helicopter communications. These networks must reliably co-exist with the British Army’s Bowman tactical communications system, used by dismounted soldiers and tactical vehicles. The Bowman tactical communications system was developed in Calgary, by General Dynamics Canada.

The training system communications are a critical factor in deployment of increasingly complex and larger training deployments. Current AWES radios limit the number of “players” or position refresh, 3G becomes slow with high usage and aging OCCN equipment is restrictive. Gareth outlined work that is ongoing to improve the BATUS communications network required to support new training systems and provide high mobility users with reliable high-speed data across the 1700 square kilometer training area.

SA 80 A2 with a AWES laser transmitter

Consistently looking to new innovations in technology to address challenges of providing realistic battlefield training. BATUS is focused on the future needs of training the soldier. Its plan for the future training support systems includes integrating improved simulation aspects and "battlebox" applications on tablets to support training. To improve live firing exercise performance with real time data capture for near hits and control of simulated targets. This will be implemented with improved target simulators within the AWES system, equipped with instrumentation, data capture and two way communications, enabling a real time record of hit and miss locations and target presentation control.



Vision of the Future BATUS Training System

Development and Optimization of Thermal EOR Methods for Unconventionals – From Concepts to Field Applications

By R.G. (Gord) Moore and S.A. (Raj) Mehta, In-situ Combustion Research Group, University of Calgary

October 14, 2015

Raj and Gord began with a few statistics about Calgary, being the oil capital of Canada, the University and the Schulich School of Engineering, but moved quickly to the topic of the talk. While Canada has the third highest oil reserves in the world, much of it is in "unconventional" fields: indeed more oil is produced from the oil sands on a daily basis than from conventional recovery. Oil sands can be mined when near the surface and upgraded, but a major breakthrough to access deeper reserves was the introduction of Steam Assisted Gravity Drainage (SAGD). Although the concept was ridiculed in some quarters initially, many variations on the theme have since been developed and implemented. Research on optimizing the process still continues. The basic idea is to mobilize the bitumen by heating it and then to extract it on a well separate from the one used to inject the steam. Some systems use liquids in addition to steam to mobilize the bitumen.

Rather than generating steam and pumping it underground, it should require less energy input to burn a small percentage of the bitumen in the reservoir to heat the rest and move it toward the production well. This is the fundamental concept behind in-situ combustion. In a successful in-situ combustion system, there is a very small zone of steam ahead of the burning front, but the heat is conducted away from the front much faster than the fire-front progresses, so the bitumen ahead of the steam layer warms up, becomes more mobile and is pushed toward the production well. Problems can occur if the pores in the rock become plugged, so hybrid systems have been tried where cyclic steam stimulation is used in addition to the combustion. Examples discussed were BP's Marguerite lake operation and Encana's air injection and displacement gas over bitumen project. A variation of the latter was used by Cenovus, where the top layer of gas was burned, with the bitumen below being extracted from horizontal wells at the base of the bitumen layer – gravity being used to drain the warmed bitumen to the wells. SAGD had also been used in combination with in-situ combustion. One application was to use the flue gases from combustion to keep the chamber pressurized so that the oil would continue to move. Another approach was to co-inject steam and oxygen in proportions to provide equal

reservoir volumes, or equal energy input from the steam and the combustion.

In mature SAGD operations, where the old wells are becoming uneconomic, you can't stop injecting steam, so in some cases, natural gas has been used to pressurize the well so the steam from adjacent wells is kept there, rather than being drawn into the exhausted chamber. It is actually more economic to block the migration of the steam with temperature – so to initiate in-situ combustion in the remaining bitumen in the exhausted chamber. Research continues on how to optimize this approach.

Dr. Mehta then went on to discuss the STAR process (Synchronized Thermal Additional Recovery) being implemented by Pacific Rubiales. This was a system used for production above an aquifer with an expected recovery rate of 45%. In the test site of 21 acres, production was begun with steam injection which was switched to steam and air after peak production, resulting in in-situ combustion and a much slower decline in production than would have occurred with steam alone. There was no need to ignite the bitumen for production as typically the down-hole conditions allowed self-ignition once sufficient oxygen was present. What was needed was compressed air, and the air compressor facilities were something to see. In-situ combustion was being used very successfully at fields in India, Romania and North America. Production details of some of the projects were discussed. For example at the Suplacu de Barcau site in Romania, as of Jan 2006, the combustion front exceeded 10 km, there were 90 air injectors and 24 steam injectors working bitumen toward 800 production wells, with a recovery factor of 52%. There was a wide variety of successful projects as outlined in Figure 1.

Air compression for in-situ combustion was much more energy efficient than SAGD as shown in Figure 2.

Figure 1. Summary of Commercial and successful in-situ combustion projects.

Steam Generator Rating		Equivalent Air Rate at 6 MPa		Energy to Compress
(MMBTU/h)	*(MW)*	*($E3m^3(ST)/d$)*	*(MMscfd)*	*(MW)*
25	7.3	170	6	1.2
50	14.7	341	12	2.5
100	29.3	681	24	4.9
180	52.8	1227	43	8.9

Figure 2. Comparison of steam and air compression equivalents.

Dr. Mehta concluded the presentation with a summary of the research performed by the in-situ combustion research group, noting they had been involved in over 150 reservoirs worldwide, associated with over 100 companies providing data to help those companies increase the yields from their reservoirs. The research facilities at the University (Figure 3) allowed them to test the bitumens at their in-situ conditions (up to 6000 psi) in a variety of ways. Drs. Mehta and Moore answered numerous questions, and were applauded for the informative and thought-provoking presentation and responses.

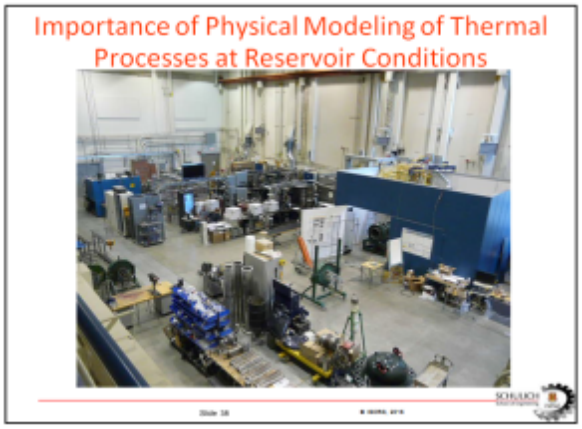


Figure 3. Research Facilities at the University.

Biomimicry: The next engineering revolution

November 25, 2016

By Marjan Eggermont Senior Instructor in Mechanical and Manufacturing Engineering, University of Calgary.

Ms. Eggermont gave one of the most unusual presentations the CPGCE has ever staged. The talk presented an approach to engineering education which challenges the way we currently engineer today: Biomimicry or bio-inspired design. Marjan has a degree in military history, not an obvious qualification for teaching engineers design. Her intent is to widen the engineer's perspective beyond function and code driven design; investigate nature as a source for creative solutions. There is a discussion within the biomimicry field as to whether a design had to be bio sustainable to be considered compliant with the concept. The presenter did not believe a design had to be bio sustainable to be defined as biomimetric.

There are every day examples of biomimicry; perhaps the most ubiquitous is Velcro where a Swiss engineer George de Mestral designed a fastener based on the burs (spikey seed pod) he found in his dog's coat. Other examples are:

- Barbed wire based on Osaga Orange thorns
- Ship camouflage based on Zebra stripes
- Sharkskin riblets on ships to reduce water drag

Biomimicry focuses on innovation emulating natural forms, processes, and ecosystems to create more functional and sustainable designs. One process used is to create a map of challenges and strategies based on an animal or plant that can be found on asknature.org.

The Lotus Leaf challenge map example illustrates the mapping process and how it develops and defines the 'design' issues that arise from the challenge and strategies. The map outlines the challenges and strategies in a step by step graphical process and determines the design issues required to be resolved to meet the initial challenge. When the map is complete the students are requested to produce an abstraction from the map; i.e. the design issue(s) which arise from the challenge and strategies in the map and research how nature has achieved these goals and how these can be used in potential projects. In the case of the lotus leaf to maximize the photosynthesis it is necessary to keep the leaf surface clean. This is achieved through beading the water and the lotus leaf has developed a surface structure that realizes this effect. This surface finish is now mimicked to produce low maintenance finishes.

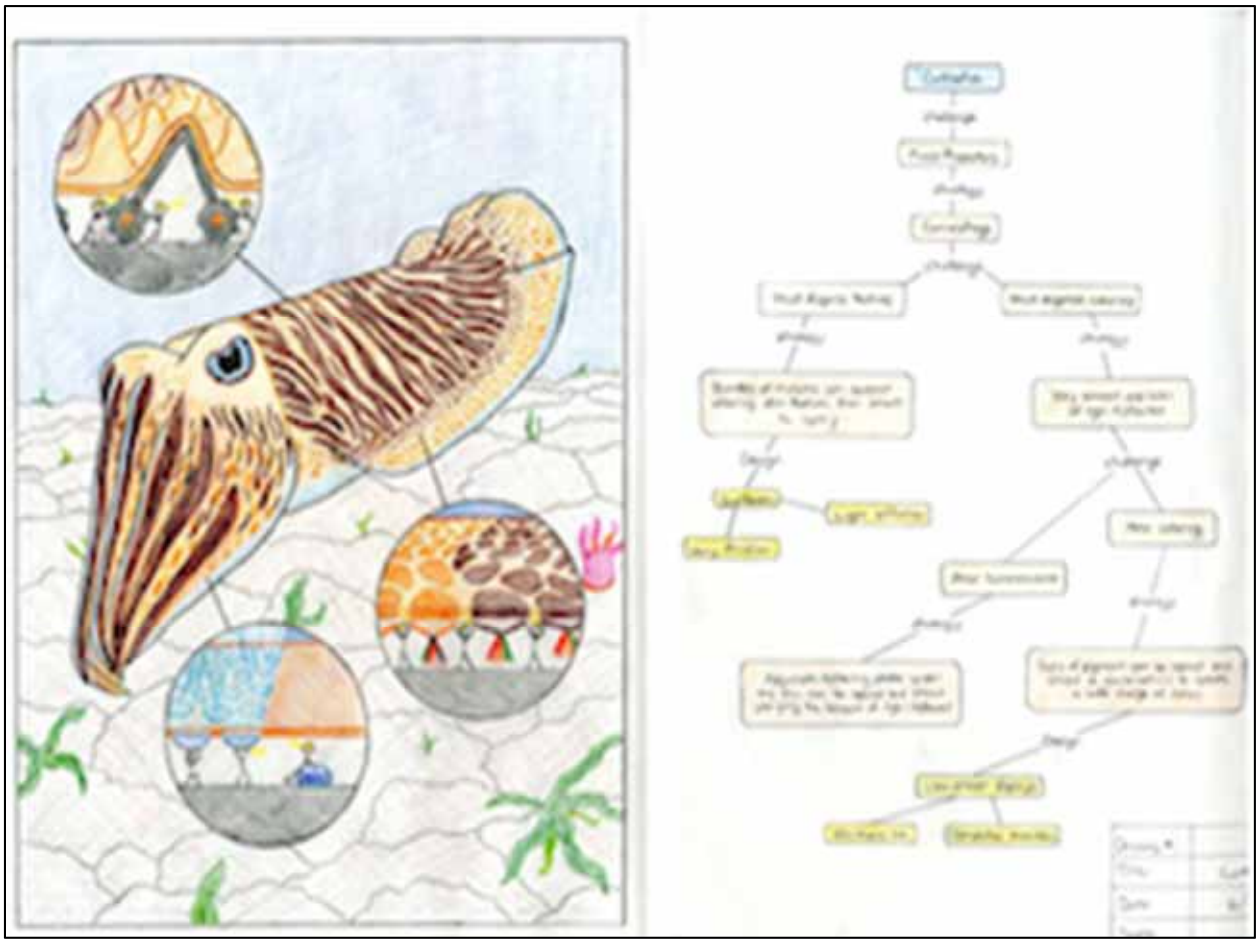
Lotus Leaf
challenge map

Water beading on leaf and microscopic graphic of leaf

Diagram courtesy of Carl Hastrich | OCAD

An interesting animated example of an abstraction of the human body [Der Mensch als Industriepalast, Man as Industrial Palace] functions can be viewed at https://vimeo.com/6505158.

The presentation then reviewed some biomimicry maps and abstractions developed by her students. These included chameleon eyes, camel survival in dessert, human heart, African Swallowtail butterfly wing- camouflage, attraction and warning, bivalve mollusc opening muscle, the Blue Mussel attachment, Knife Fish propulsion mechanism and Cuttlefish camouflage. The latter is illustrated.



The presenter coedits a quarterly online journal zqjournal.org, which covers, Case studies, Interviews, Tools and methodologies and The Science of Seeing.

Issus coleoptratus

The final topic was a paper titled Gearing Up (and away): how a little backyard bug called a planthopper (Issus coleoptratus) might change engineering by Tom McKeag. The young insect develops geared spurs on each of their hind legs, that intermesh, keeping the legs synchronized when the insect jump. This enables the insect to make extraordinary long jumps for its size. On moulting into an adult the bug loses these spurs. These spurs or 'gears' are recessed, remarkably self-aligning and backlash free (any tension in the animal takes up 'play'). The 'gears are a one directional timing mechanism; they don't transmit much power but they allow very precise orchestrated movements. A model of these gears has been produced from a digital printer. This was challenging for the 3D printer because the mathematical representation of these gears does not follow any standard mathematical model but rather an empirical functionality from millions of years of natural Darwinian development. Not many animals have these spurs yet it looks like a robust system capable of dealing with more shape variation in the 'teeth' than the engineering equivalent in gear trains. It is expected that applications will evolve in mechanisms, ad hoc hinges and latches, in occasionally used orchestrated movements (closing jaws, multi-linkage mechanisms).

Kingfisher beak basis for E5 Shinkansen train

Issus coleoptratus

The geared spurs and in general biomimicry highlight a significant engineering design opportunity. Engineers are 'limited' by mathematical techniques and training in their designs whereas nature relies on millions of years of natural development to perfect a design. A combination of engineering coupled with biomimicry should provide optimal designs for the future. In the closing vote to Marjan for a thought provoking presentation it was highlighted that the Japanese engineers had copied the profile of a kingfisher's beak for their latest Shinkansen (bullet) train's streamlined nose design to emulate the minimal splash when a kingfisher dives into the water. Further the Shinkansen low noise pantograph used design elements from an owl's wing because of the latter's near silent flight.

3D printer gears

Scientific breakthroughs of 2015

First new Antibiotic discovered in the last 30 years.

While still in pre-clinical development Teixobactin has been shown to be effective against several pathogens, including strains of staph, which have shown drug-resistance.

Support found for Albert Einstein's spooky theory

Three independent experiments have been conducted in 2015 that have shown the quantum phenomenon. Two subatomic particles can be so closely connected that one can influence the other over long distances.

Just for Fun…

A Long Life

An old Mechanical Engineer was talking to his intern about his long life in the industry and how to keep fit and well, when the young Engineer asked how he had lasted so long, to which he replied:

For better digestion I drink beer, in the case of appetite loss I drink white wine, for low blood pressure I drink red wine, for high blood pressure I drink scotch and to help me over a cold or flu I drink peach schnapps.

The young engineer pondered this and asked, "When do you drink water?"

The old Engineer smiled and said "water??!! I've never been that sick!"

Mechanicals and Civils

Remember, Mechanical Engineers build weapons, Civil Engineers build the targets to prove them on

Life of Pi

If you ask a scientist what pi is, he'll tell you it equals 3.14159. If you ask a mathematician, he'll tell you pi equals the circumference of a circle divided by its diameter. If you ask an engineer, he'll say "Pi? Well, it's about 3, but we'll call it 4 just to be safe." But if you ask a kid, he'll ask if he can have ice cream with it.

Special thanks to Rick Marshall for providing his humour.

Upcoming Events

DATE	TOPIC	PRESENTER(S)
30th Jan, 2016	**CPGCE AGM – STARS**	**Scott Young, VP Aviation**
10th Feb, 2016	The Changing Requirements in Engineering Education	Dr. Bob Brennan, Head of Mechanical and Manufacturing Engineering U of C
9th March, 2016	Canadian Light Source (synchrotron)	TBD
13th April, 2016	Canadian DND – DRDC Suffield Biological & Chemical Research Centre	Dr. Scott Duncan
11th May, 2016	Airside Operations	Doug Francoeur Director, Airside at YYC
8th June, 2016	D-Day Engineering Challenges & Solutions	E. (Eppo) van Weelderen
14th September, 2016	TBD	TBD
12th October, 2016	TBD	TBD
9th November, 2016	TBD	TBD

Acknowledgements

The Editor would like to express their gratitude to everyone who submitted a story, wrote an abstract for the newsletter, and send a joke in. If you have a story you would like to see included please contact Mia Jović at editor_newsletter@cpgce.org.